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workers, the methods employed have as a rule been crude and inexact, leading to much uncertainty in the results. Still it is evident that there was an increase in the water requirement when the soil moisture content approached either extreme; when the soil was deficient in any plant food element; when the amount of soil used in the experiment was small; and when shading of the plants occurred. Atmospheric conditions profoundly affected the water requirement, being greater in dry than in moist air.

The extensive experiments of the present investigators in 1910 and 1911 were conducted at Akron, Colo., with plants grown in water-tight pots containing about 115 kilos of soil each, so sealed that the loss of water was limited to that resulting from the transpiration of the plants, water being added as required. Among other results, it was found that wheat consumed an average of 507 kilos of water for each kilo of dry weight produced, and taking this as the standard (100), the relative water requirements of certain other plants were as follows: alfalfa 211; rye 143; oats 122; barley 106; potato 88; maize 73; sorghum 60; millet 54; and such weeds as *Amaranthus retroflexus* and *Salsola pestifer* 63. These results would indicate the great suitability of sorghum and millet for semi-arid regions. The bulletins contain a mass of detail and much additional data valuable to students of the agriculture and ecology of the great plains.—GEO. D. FULLER.

Agriculture on acid lands.—It has long been known that moors and heaths have acid soil, and many ecological classifications, such as that of WARMING, regard acidity as the chief determining factor of the vegetation. In several interesting and important papers, COVILLE[36] has given the results of some experiments that should almost revolutionize certain phases of agricultural practice. As is well known, various species of *Vaccinium* and *Gaylussacia* are commonly sold in the markets as blueberries and huckleberries, and yet are not cultivated, as are most other commercial fruits. Many attempts have been made to cultivate these berries, and their failure is attributed by COVILLE to the fact that their cultivation has been attempted in rich garden soil. Ordinary cultivated plants, such as alfalfa or roses, grow well in rich garden soil and poorly in peat, unless the acidity of the latter is neutralized by lime. The blueberry, on the other hand, grows poorly in garden soil, thrives in peat, and grows poorly in peat neutralized by lime. After describing the root fungi and their probable rôle in making nitrogen available, the author gives directions for germinating and growing blueberries, showing that fruiting plants can be had in a year or two from seed. It is suggested, however, that cuttings will generally prove more desirable. Of much importance is the fact that in COVILLE'S experiments there were produced berries much beyond the usual size. The experiments were made chiefly on *Vaccinium corymbosum*, but it is believed that other species would show similar behavior.

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[36] COVILLE, F. V., Experiments in blueberry culture. U.S. Bur. Plant Ind. Bull. 193. pp. 100. *pls. 18. figs. 31.* 1910.

———, The formation of leaf mold. Jour. Wash. Acad. Sci. 3:77–89. 1913.

———, Directions for blueberry culture. U.S. Dept. of Agric. Circular 122. pp. 11. 1913.

———, The agricultural utilization of acid lands by means of acid-tolerant crops. U.S. Dept. of Agric. Bull. 6. pp. 13. 1913.

In one of the later papers, COVILLE describes the changes in the formation of leaf mold, noting its early acidity and its subsequent alkalinity; whereas, peat (not only lowland peat, but also upland peat, as he terms it) retains its acidity, because of the comparative suspension of decay. In another paper, he urges farmers to utilize some of their acid soils by the growth of acid-tolerant plants, and not universally to neutralize them by the use of lime. The work of COVILLE is an excellent illustration of the application of ecological methods to agriculture.—H. C. COWLES.

Sexuality of Mucorales.—In his studies on the sexuality of the Mucorales, BLAKESLEE observed that the sporangium originating from the zygospore of *Phycomyces nitens* contains spores which with respect to sexual differentiation are of three types, giving rise respectively to plus, minus, and neutral mycelia. To account for the occurrence of these three sexually differentiated strains, BURGEFF[37] has formulated a hypothesis according to which the nature of the mycelium is determined by the nuclei which it contains. These may be either (+) or (−), and, since the spores contain one or more nuclei, it is evident that a particular spore may contain either all (+), or all (−), or both (+) and (−) nuclei. In the first two cases, the spores and the mycelium which they produce are said to be "homokaryotic," and in the other case "heterokaryotic." This hypothesis he tested in an ingenious manner. By inserting the tip of a young sporangiophore into the cut basal end of another of the opposite strain, and applying pressure to the wall of the outer one, he was able to rupture the tip of the inner hypha and bring about a mixture of the two masses of protoplasm with their respective (+) and (−) nuclei. Cultures from the sporangia produced by this "mixochimaera" gave (+), (−), and neutral mycelia.

He describes an analogous case of heterokaryosis presented by *Phycomyces nitens* var. *piloboloides*, which differs from the parent in the form of its sporangiophores. The spores of this variety give rise to mycelia which produce either *nitens* sporangiophores only, or *piloboloides* sporangiophores only, or both kinds mixed on the same mycelium. The homokaryotic types remain pure, but the mixed type continues to split in the manner described. Mixochimaeras, formed from the pure selected types, give rise to all three forms. Crosses of *P. nitens* with rigidly selected strains of the variety give rise to all possible forms of both (+) and (−) strains of both types and to heterokaryotic combinations. The production by means of the cross of a (−) strain of var. *piloboloides*, which is (+), is of special interest.—H. HASSELBRING.

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[37] BURGEFF, H., Über Sexualität, Variabilität, und Vererbung bei *Phycomyces nitens*. Ber. Deutsch. Bot. Gesells. **30**:679–685. 1913.